

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of Claims:

112. (Original) An isotopic gas analyzer for determining the ratio of at least a first and a second isotopic component of a gas, comprising:

at least one wavelength-stable source of radiation of wavelengths characteristic of at least one of said at least first and second isotopic components;

at least a first sample chamber comprising a first sample of said gas to be analyzed;

at least a first reference chamber containing a reference gas comprising said first and second isotopic components;

at least a second sample chamber comprising a second sample of said gas to be analyzed;

at least a second reference chamber containing a reference gas comprising said first and second isotopic components; and

at least one detector detecting transmission through said at least first sample chamber and transmission through said at least first reference chamber, of radiation of wavelengths characteristic of said first isotopic component of said gas, and transmission through said at least second sample chamber and transmission through said at least second reference chamber, of radiation of wavelengths characteristic of said second isotopic component of said gas.

113. (Original) An isotopic gas analyzer according to claim 112, and wherein said at least one detector is a single detector.

114. (Original) An isotopic gas analyzer according to claim 112, and wherein said at least one detector detects said transmission through said

chambers simultaneously at wavelengths characteristic of said first isotopic component of said gas, and of said second isotopic component of said gas.

115. (Original) An isotopic gas analyzer according to claim 113, and wherein said single detector detects said transmission through said chambers simultaneously at wavelengths characteristic of said first isotopic component of said gas, and of said second isotopic component of said gas.

116. (Original) An isotopic gas analyzer according to claim 112, and wherein said at least one wavelength-stable source of radiation comprises at least two wavelength-stable sources of radiation, each of wavelengths characteristic of one isotopic component of said gas.

117. (Original) An isotopic gas analyzer according to claim 113, and wherein said at least one wavelength-stable source of radiation comprises at least two wavelength-stable sources of radiation, each of wavelengths characteristic of one isotopic component of said gas.

118. (Original) An isotopic gas analyzer according to claim 112, and wherein said at least one wavelength-stable source of radiation is one wavelength-stable source of wavelengths characteristic of at least said first and second isotopic components.

119. (Original) An isotopic gas analyzer according to claim 113, and wherein said at least one wavelength-stable source of radiation is one wavelength-stable source of wavelengths characteristic of at least said first and second isotopic components.

120. (Original) An isotopic gas analyzer according to claim 112, and wherein said at least one wavelength-stable source is at least one gas discharge lamp.

121. (Original) An isotopic gas analyzer according to claim 113, and wherein said at least one wavelength-stable source is at least one gas discharge lamp.

122. (Currently amended) An isotopic gas analyzer according to claim 112, and wherein said at least one wavelength-stable source comprises at least one filter to define said wavelengths characteristic of at least one of said first and second isotopic components.

123. (Original) An isotopic gas analyzer according to claim 116, and wherein said at least two wavelength-stable sources are gas discharge lamps.

124. (Original) An isotopic gas analyzer according to claim 118, and wherein said at least one wavelength-stable source is at least one gas discharge lamp.

125. (Original) An isotopic gas analyzer according to claim 112 and wherein at least one of the environmental conditions of at least one of said samples of said gas and said reference gas are the same.

126. (Original) An isotopic gas analyzer according to claim 113 and wherein at least one of the environmental conditions of at least one of said samples of said gas and said reference gas are the same.

127. (Original) An isotopic gas analyzer according to claim 125 and wherein said reference gas comprises at least part of a sample of said gas.

128. (Original) An isotopic gas analyzer according to claim 125 and wherein said reference gas is a mixture containing at least one of said isotopic components at a known pressure and concentration.

129. (Original) An isotopic gas analyzer according to claim 112 and wherein said first sample of said gas and said second sample of said gas have essentially the same composition.

130. (Original) An isotopic gas analyzer according to claim 116 and wherein said at least two wavelength-stable sources of radiation operate with respective at least first and second different timing characteristics, said analyzer also comprising a detection differentiator receiving an output from said at least one detector and distinguishing outputs corresponding to said at least at least two wavelength-stable sources on the basis of said first and second different timing characteristics.

131. (Original) An isotopic gas analyzer according to claim 130 and wherein said at least first and second different timing characteristics are first and second frequencies.

132. (Original) An isotopic gas analyzer according to claim 130 and wherein said at least first and second different timing characteristics are first and second phases.

133. (Currently amended) An isotopic gas analyzer according to claim 130 and wherein said at least one detector ~~viewing outputs of said at least two wavelength-stable sources in the presence of gas to be analyzed~~ is a single detector viewing outputs of said at least two wavelength-stable sources.

134. (Currently amended) An isotopic gas analyzer according to claim 130 and wherein said at least one detector ~~viewing outputs of said two wavelength-stable sources in the presence of gas to be analyzed~~ are comprises two detectors, each viewing one of said at least two wavelength-stable sources of radiation ~~first and second gas discharge lamps~~.

135. (Currently amended) An isotopic gas analyzer according to claim ~~134~~130 and wherein said at least one detector comprises two detectors, and wherein one of said two detectors views absorption signal outputs from said at least two wavelength-stable sources and the other of said two detectors views zero calibration signals from said at least two wavelength-stable sources.

136. (Original) An isotopic gas analyzer according to claim 130 and wherein said detection differentiator comprises first and second synchronized signal processors.

137. (Original) An isotopic gas analyzer according to claim 120, and wherein said at least one gas discharge lamp is a single gas discharge lamp containing at least a first and a second excitation gas.

138. (Original) An isotopic gas analyzer according to claim 120, and wherein said at least one gas discharge lamp is two gas discharge lamps, containing respectively a first and a second excitation gas.

139. (Original) An isotopic gas analyzer according to claim 137, and also comprising:

at least first and second filters, each corresponding to a part of respective first and second spectra of said at least first and second excitation gas, said filters being interposed between said at least one wavelength-stable source of radiation and said at least one detector; and

a detection differentiator cooperating with said detector for distinguishing detector outputs corresponding to said first and second spectra.

140. (Original) An isotopic gas analyzer according to claim 139, and wherein said detection differentiator comprises at least one light valve

modulating light passing through at least one of said first and second filters, in accordance with a known timing sequence.

141. (Original) An isotopic gas analyzer according to claim 140 and wherein said light valve is a chopper.

142. (Original) An isotopic gas analyzer according to claim 140 and wherein said light valve is a spatial light modulator.

143. (Original) An isotopic gas analyzer according to claim 140 and wherein said at least one light valve is operated with respective first and second different timing characteristics, and wherein said detection differentiator also comprises a detector output discriminator receiving an output from said detector and distinguishing outputs corresponding to said first and second excitation gases on the basis of said first and second different timing characteristics.

144. (Original) An isotopic gas analyzer according to claim 143 and wherein said first and second different timing characteristics are first and second frequencies.

145. (Original) An isotopic gas analyzer according to claim 144 and wherein said first and second different timing characteristics are first and second phases.

146. (Original) An isotopic gas analyzer according to claim 144 and wherein said detection differentiator comprises first and second synchronized signal processors.

147. (Original) An isotopic gas analyzer according to claim 137, and wherein said first and second excitation gases are isotopically labeled.

148. (Original) An isotopic gas analyzer according to claim 137, and wherein said filters are at least one of optical and gaseous filters.

149. (Original) An isotopic gas analyzer according to claim 137, and wherein said at least first and second excitation gases having overlapping spectral ranges including at least some interdigitated spectral lines; and also comprising a gas contents indicator receiving an output from said at least one detector and employing information detected by said at least one detector from at least two of said at least some interdigitated spectral lines.

150. (Original) An isotopic gas analyzer according to claim 149 and wherein said gas to be analyzed is maintained at a pressure below atmospheric pressure.

151. (Original) An isotopic gas analyzer according to claim 149 and also comprising filters to isolate non overlapping spectral ranges including at least some interdigitated spectral lines.

152. (Original) An isotopic gas analyzer according to claim 112 and also comprising osmotic means for achieving substantially the same isotopic concentration in said sample of gas and said reference gas.

153. (Original) An isotopic gas analyzer according to claim 113 and also comprising osmotic means for achieving substantially the same isotopic concentration in said sample of gas and said reference gas.

154. (Original) An isotopic gas analyzer according to claim 112 and also comprising pumping means for achieving substantially the same isotopic concentration in said sample of gas and said reference gas.

155. (Original) An isotopic gas analyzer according to claim 113 and also comprising pumping means for achieving substantially the same isotopic concentration in said sample of gas and said reference gas.

156. (Original) An isotopic gas analyzer according to claim 112, and also comprising mechanical means for changing the length of at least one of said sample chambers and reference chambers for achieving substantially the same isotopic absorption in said sample of gas and said reference gas.

157. (Original) An isotopic gas analyzer according to claim 113, and also comprising mechanical means for changing the length of at least one of said sample chambers and reference chambers for achieving substantially the same isotopic absorption in said sample of gas and said reference gas.

158. (Original) An isotopic gas analyzer according to claim 112 and wherein said analyzed gas is exhaled breath.

159. (Original) An isotopic gas analyzer according to claim 113 and wherein said analyzed gas is exhaled breath.

160. (Original) An isotopic gas analyzer according to claim 158 and wherein said exhaled breath is continuously sampled by means of a connecting nasal cannula.

161. (Original) An isotopic gas analyzer according to claim 158 and wherein said exhaled breath is continuously sampled by means of a breathing tube.

162. (Original) An isotopic gas analyzer according to claim 158 and wherein only a selected part of said exhaled breath is used for said analyzing.

163. (Currently amended) An isotopic gas analyzer according to claim 140, and also comprising a zero calibration channel, and wherein said light modulation is also operative to modulate light transmitted through at least one of said sample chambers, reference chambers and ~~a zero reference channel~~ said zero calibration channel.

164. (Original) An isotopic gas analyzer according to claim 112 and also comprising a beam homogenizer to compensate for inhomogeneity in an optical path.

165. (Original) An isotopic gas analyzer according to claim 113 and also comprising a beam homogenizer to compensate for inhomogeneity in an optical path.

166. (Original) An isotopic gas analyzer according to claim 112 and wherein the spectral ranges of said at least first and second isotopic components are non-overlapping.

167. (Original) An isotopic gas analyzer according to claim 113 and wherein the spectral ranges of said at least first and second isotopic components are non-overlapping.

168. (Currently amended) An isotopic gas analyzer according to claim 112 and also comprising an array of detectors monitoring at least one of said sample chamber, said reference chamber and ~~a zero reference channel~~ said zero calibration channel.

169. (Original) An isotopic gas analyzer according to claim 112 and wherein said sample chambers are interconnected pneumatically.

170. (Original) An isotopic gas analyzer according to claim 113 and wherein said sample chambers are interconnected pneumatically.

171. (Original) An isotopic gas analyzer according to claim 112 and wherein said reference chambers are interconnected pneumatically.

172. (Original) An isotopic gas analyzer according to claim 113 and wherein said reference chambers are interconnected pneumatically.

173. (Original) An isotopic gas analyzer according to claim 112 and wherein said sample chambers are connected thermally.

174. (Original) An isotopic gas analyzer according to claim 113 and wherein said sample chambers are connected thermally.

175. (Original) An isotopic gas analyzer according to claim 112 and wherein said reference chambers are connected thermally.

176. (Original) An isotopic gas analyzer according to claim 113 and wherein said reference chambers are connected thermally.

177. (Original) An isotopic gas analyzer according to claim 112 and wherein said first and said second isotopic components of said gas have a region of spectral overlap, and also comprising a system for lowering the pressure of said sample of gas, such that an absorption measurement in said region of spectral overlap is performed under conditions of lowered sample gas pressure.

178. (Original) An isotopic gas analyzer according to claim 113 and wherein said first and said second isotopic components of said gas have a region of spectral overlap, and also comprising a system for lowering the pressure of said sample of gas, such that an absorption measurement in said region of

spectral overlap is performed under conditions of lowered sample gas pressure.

179. (Original) An isotopic gas analyzer comprising:

- at least first and second gas discharge lamps operated with respective first and second different timing characteristics;

- at least two detectors, one viewing absorption signal outputs from said at least first and second gas discharge lamps, and the other of said at least two detectors viewing zero calibration signals from said at least first and second gas discharge lamps; and

- a detection differentiator receiving an output from said at least two detectors and distinguishing outputs corresponding to said first and second gas discharge lamps on the basis of said first and second different timing characteristics.

180. (Original) An isotopic gas analyzer for determining the ratio of at least a first and a second isotopic component of a gas, comprising:

- at least one wavelength-stable source of radiation of wavelengths characteristic of at least one of said at least first and second isotopic components;

- at least a first sample chamber comprising a first sample of said gas to be analyzed;

- at least a first reference chamber containing a reference gas comprising one of said first and second isotopic components;

- at least a second sample chamber comprising a second sample of said gas to be analyzed;

- at least a second reference chamber containing a reference gas comprising one of said first and second isotopic components; and

- at least one detector determining transmission through said at least first sample chamber and transmission through said at least first reference chamber, of radiation of wavelengths characteristic of said first isotopic component of said gas, and transmission through said at least second sample chamber and transmission through said at least second reference chamber, of

radiation of wavelengths characteristic of said second isotopic component of said gas.

181. (Original) An isotopic gas analyzer according to claim 180, and wherein said at least one detector is a single detector.

182. (Original) An isotopic gas analyzer according to claim 180, and wherein said at least one detector detects said transmission through said chambers simultaneously at wavelengths characteristic of said first isotopic component of said gas, and of said second isotopic component of said gas.

183. (Original) An isotopic gas analyzer according to claim 181, and wherein said single detector detects said transmission through said chambers simultaneously at wavelengths characteristic of said first isotopic component of said gas, and of said second isotopic component of said gas.

184. (Original) An isotopic gas analyzer according to claim 180, and wherein said at least one wavelength-stable source of radiation comprises at least two wavelength-stable sources of radiation, each of wavelengths characteristic of one isotopic component of said gas.

185. (Original) An isotopic gas analyzer according to claim 181, and wherein said at least one wavelength-stable source of radiation comprises at least two wavelength-stable sources of radiation, each of wavelengths characteristic of one isotopic component of said gas.

186. (Original) An isotopic gas analyzer according to claim 180, and wherein said at least one wavelength-stable source of radiation is one wavelength-stable source of wavelengths characteristic of at least said first and second isotopic components.

187. (Original) An isotopic gas analyzer according to claim 181, and wherein said at least one wavelength-stable source of radiation is one wavelength-stable source of wavelengths characteristic of at least said first and second isotopic components.

188. (Original) An isotopic gas analyzer according to claim 180, and wherein said at least one wavelength-stable source is at least one gas discharge lamp.

189. (Original) An isotopic gas analyzer according to claim 181, and wherein said at least one wavelength-stable source is at least one gas discharge lamp.

190. (Currently amended) An isotopic gas analyzer according to claim 180, and wherein said at least one wavelength-stable source comprises at least one filter to define said wavelengths characteristic of at least one of said first and second isotopic components.

191. (New) An isotopic gas analyzer according to claim 117, said at least two wavelength-stable sources of radiation operating with respective at least first and second different timing characteristics, said analyzer also comprising a detection differentiator receiving an output from said at least one detector and distinguishing outputs corresponding to said at least two wavelength-stable sources on the basis of said first and second different timing characteristics.

192. (New) An isotopic gas analyzer according to claim 191 and also comprising a second detector, wherein said single detector views absorption signal outputs from said at least two wavelength-stable sources and said second detector views zero calibration signals from said at least two wavelength-stable sources.